


CLAY ADAMS™ 

CA6000


Centrifuge User's Manual

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1 Introduction

1.1 Overview – Functional Principles

The Clay Adams™ CA6000 centrifuge is a multipurpose centrifuge designed for laboratory use in performing separation and sedimentation procedures. Through the application of a Relative Centrifugal Force (RCF) it allows the separation of substances made of different density elements. Potential applications include hematology, chemistry, urinalysis, blood banking, microbiology, cytology, pharmacology, food processing, and agriculture.

Specific features include:

- ◆ Microprocessor controlled
- ◆ 5 Program (Memory) Settings
- ◆ Speeds from 300 – 6500 rpm in 10 rpm increments
- ◆ High or low acceleration (5 preprogrammed settings)
- ◆ High or low deceleration (4 preprogrammed settings plus inertial)
- ◆ Timer from 1 minute to 99 minutes plus “infinite” state
- ◆ Electronic-accelerometric imbalance encoder
- ◆ Direct drive system
- ◆ Brushless induction drive motor

Drive System

The centrifuge is driven by a three phase asynchronous motor. It is situated in the center of a sealed and armor plated centrifugation chamber.

Safety Interlock System

The CA6000 centrifuge is equipped with an interlock system that prevents opening of the centrifuge lid when the rotor is spinning. The centrifuge will not operate until the lid is closed and latched in place. The lid remains latched until the rotor stops spinning.

NOTE

If a power failure occurs, you can access the samples in the centrifuge by following the Emergency Lid Unlock procedure in Section 4.7.

Imbalance Sensor

The centrifuge is equipped with a load imbalance detector. In case of excessive imbalance the machine stops and displays the message "IMBAL." After the lid has been opened to remove the cause of the imbalance, the message disappears. Carefully balance the sample load as described in Section 4.2 to avoid activating the imbalance detection system.



Figure 1 – Clay Adams™ CA6000 Centrifuge

1.2 Safety Devices and Notices

In order to ensure both mechanical and electrical operational safety, the centrifuge features the following safety control systems:

- ☞ The centrifuge will not start unless the lid is locked. The lid cannot be opened while the rotor is spinning, even in the event of power failure.
- ☞ Safety electronic circuits for self-diagnosis (with microprocessor control); any possible breakdown of the circuits and of the sensors is shown on the display and neutralized, preventing unsafe operating conditions.
- ☞ Load imbalance detection.
- ☞ Double metal protection casing; reinforced centrifugation chamber in AISI 304 stainless steel.
- ☞ Lid anti-fall mechanism.
- ☞ Main bipolar switch.
- ☞ Normalized filters to avoid Radio Frequency Interference (RFI).
- ☞ Individual certified test, with measurements and testing of the leakage currents, the ground resistance, and the applied voltage.
- ☞ Identification plates; operating instructions.

1.3 Hazards, Precautions, and Limitations of Use

The following CAUTIONS and WARNINGS represent dangerous operations and work conditions to avoid.

- ! Using the centrifuge if it has not been properly installed.
- ! Leaning on the machine.
- ! Depositing any object in the free area of the centrifuge bowl.
- ! Using the centrifuge with rotating equipment showing evident corrosion, wear marks, or cracking on the rotating head or on the buckets.
- ! Using the centrifuge with rotating equipment and accessories not approved by Becton Dickinson.
- ! Using the centrifuge in explosion risk rooms, or with explosion risk products or chemical materials subject to violent reaction.
- ! Incorrect assembly of the rotating head on the driving stud.
- ! Imbalanced load causing an excessive vibration of the centrifuge.
- ! Failing to insert all buckets into the rotating equipment, even for partial loads.
- ! Moving or shifting the machine during centrifugation.

WARNING

**IF ANY DANGEROUS EVENT OCCURS INVOLVING THE CENTRIFUGE,
VACATE THE AREA AND SWITCH OFF THE MAIN POWER SOURCE.**

- ! Exceeding the maximum speed indicated in the “max. rpm” column of the performance table (see 4.2.2).
- ! Using old accessories on a new machine.
- ! Using tubes or bottles not suited for centrifugation.
- ! Centrifuging samples with higher density than allowed for the maximum speed, without reducing the speed limit (see Section 4.2).
- ! Manipulating or tampering with the electronic and mechanical parts.

1.4 Rotor and Accessory Precautions

1.4.1 Corrosion Information

CA6000 rotors made of aluminum alloy are designed to operate at their rated RCF for many years. With careful use they will resist corrosion, lessening the possibility of excessive imbalance, disruption and subsequent damage to the instrument. The primary conditions for the initiation of corrosion exist in every laboratory during daily use of the centrifuge. For this reason it is essential that care and attention be paid to inspection and cleaning.

CHEMICAL CORROSION

This corrosion is characterized by chemical reactions due to the existence of any electrolyte liquid on the surface of the rotating equipment. If these substances are allowed to remain on the surface, the corrosion will almost certainly occur. This produces first a discoloration of the anodization and eventually pitting of the metal.

Acidic and alkaline solutions sustaining their pH level will create problems of corrosion in aluminum equipment. Chlorides, present in salts or even in skin contact with the rotating equipment, are among the most aggressive and harmful substances commonly found in the laboratory.

Chemical products, which are the source of this corrosion do not necessarily originate from broken tubes, for example they could come from:

- ◆ Chemical vapors present in the laboratory which are dissolved in the residual humidity, in condensed water (refrigerated centrifuges) present at the base of the rotor pockets.
- ◆ Corrosive liquids originating from overfilled uncapped tubes (the liquid overflowing during centrifugation)
- ◆ Inserts, adapters, racks, bottles whose exterior has been soiled by a chemical product or poorly rinsed after decontamination (with bleach, for example)

NOTE

If the products are very corrosive, simply rinsing is insufficient. Residual traces dissolve little by little with the humidity present in the bottom of the rotor pocket.

CAUTION

BEWARE of the presence of solid particles beneath tubes, inserts, racks, or adapters. These particles are crushed by the centrifugal force and penetrate the protective, anodized layer of buckets and rotors, thus creating easy pathways for corrosion.

STRESS CORROSION

This term relates to the phenomenon of accelerated corrosion due to the effect of centrifugation when a corrosive chemical is in contact with the alloy. From the time when the aluminum alloy has been attacked by chemicals, stress corrosion begins to appear. Because the process begins on a microscopic scale it is even more dangerous than a macroscopic process since it is invisible.

During centrifugation, chemicals responsible for corrosion are also submitted to the very high “g” force which pushes them against the alloy. This close contact facilitates the chemical reaction which occurs much faster than in a static situation. Moreover, centrifugal force is very directional thus corrosion under stress creates, with a very small amount of corrosive product, straight microscopic fissures. Each centrifugation run makes the chemical migrate further and further.

Fissures or cracks, although microscopic, are cuts in the metal, breaking the material's cohesion. As one weak link in a chain allows the chain to break, so the microfissures break the chain of resistance of the accessory to centrifugal force. As accessories are designed with high levels of safety, rupture does not occur as soon as the first microfissures are produced.

Depending upon the location of the fissure, disruption may occur before it reaches the external surface of the accessory. The fissure creates a weakness which makes the accessory less and less resistant to mechanical fatigue. The corrosion by a small amount of corrosive product does not disrupt the accessory but makes it mechanically weaker and weaker until disruption occurs due to both centrifugal effort and the number of cycles.

Because stress corrosion is largely invisible, it is essential that rotating equipment be scrutinized regularly paying particular attention to susceptible parts such as the bottom of pockets, the outer edges and the base of the rotating equipment.

1.5 Contamination Hazards

Clay Adams centrifuges are likely to be used in facilities where hazardous substances (including radioactive chemicals) are frequently present.

WARNING

BLOOD AND BODY FLUIDS MAY CONTAIN THE HEPATITIS B VIRUS (HBV), HEPATITIS C VIRUS (HCV), HUMAN IMMUNODEFICIENCY VIRUS (HIV), OR OTHER DISEASE-CAUSING AGENTS. HANDLE ALL PATIENT SPECIMENS AS POTENTIAL BIOHAZARDS CAPABLE OF TRANSMITTING INFECTION. WEAR APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT, INCLUDING LABORATORY GLOVES, WHEN COLLECTING, HANDLING, AND PROCESSING BLOOD AND BODY FLUIDS.

IN ADDITION TO WEARING GLOVES, THE USE OF DISPOSABLE LAB COATS OR GOWNS AND PROTECTIVE GLASSES OR GOGGLES IS RECOMMENDED WHEN WORKING AROUND THE CENTRIFUGE.

IF A TUBE BREAKS IN THE UNIT, CAREFULLY REMOVE BROKEN GLASS WITH A HEMOSTAT OR OTHER DEVICE, USING PUNCTURE RESISTANT UTILITY GLOVES.

Always use the appropriate decontamination procedures when the rotating equipment is exposed to these chemicals. Examples of commonly used techniques are outlined in **Section 5 – Maintenance**. The information is given as a guide only. Decontamination is the responsibility of the owner to use the most suitable procedure.

The rotating equipment should always be completely disassembled before being subjected to heat and after external chemical cleaning. Seals, tubes, and plastic components should be decontaminated with the method most suitable for them (which might not be the same as for the rotating equipment).

1.6 Manual Structure

This user's manual contains the following sections:

Section 1 – Introduction – provides an overview of the CA6000 centrifuge and its uses in the laboratory.

Section 2 – Installation and Setup – gives specifications for installation of the centrifuge and instructions for setup.

Section 3 – Controls and Indicators – explains the use and meaning of all controls and indicators of the unit.

Section 4 – Operation – provides instructions for routine daily activities.

Section 5 – Maintenance – explains all user system maintenance, including parts replacements.

Section 6 – Troubleshooting – provides a convenient guide for identifying and correcting system malfunctions.

The **Appendices** contain warranty information, parts and accessories list, a listing of Becton Dickinson international contacts, and an exploded view drawing.

1.7 Use of this Manual

This user's manual is designed as a reference tool for technologists, supervisors, and other personnel who operate and maintain the CA6000 centrifuge on a regular basis. Every attempt has been made to include all information which would be required during normal use and maintenance. Should a question arise which is not answered in this manual, please contact the following parties (USA):

For assistance with mechanical or electrical performance problems:

☎ Field Service 1–800–544–7434

For procedural questions:

☎ Technical Services 1–800–631–8064

International contacts are listed in Appendix D.

1.8 Manual Conventions

1.8.1 Symbols Used on the Equipment



Figure 2 – Symbols Used on the CA6000 Centrifuge

Left figure: Symbol for electrical hazard; Middle figure: Symbol for “refer to accompanying documentation” (specifically, the user’s manual) for instructions; Right figure: Symbol for fuse.

1.8.2 Notes, Cautions, and Warnings

Throughout this manual, important information is presented in boxes offset from the regular text, and is labeled as either a NOTE, CAUTION, or WARNING. These messages are formatted as shown below and bear the following significance:

NOTE

Important information about system use worthy of special attention is presented as a NOTE.

CAUTION

Information on an activity which potentially could cause damage to the centrifuge is presented as a CAUTION.

WARNING

INFORMATION ON AN ACTIVITY WHICH POTENTIALLY COULD CAUSE INJURY TO THE USER IS PRESENTED AS A WARNING.

2 Installation and Setup

2.1 Transport, Packaging, Lifting

Due to the weight of the CA6000 centrifuge, all lifting and transporting must be carried out using proper handling equipment (e.g., forklift) that complies with current regulations, and by people with the necessary training.

The centrifuge may be transported and stored in ambient temperatures from -20°C to 50°C , and relative humidity up to 90% (non-condensing).

During transport the centrifuge is seated in a special packaging. Unpack the centrifuge, carefully removing first the rotating equipment, any possible accessories and the material supplied for ordinary maintenance. Check the contents of packaging against the packing list and note any damage to the shipping carton. If damage is observed, notify the carrier immediately.

Keep the packaging until the centrifuge has been set up and tested.

WARNING
**DUE TO ITS SIZE AND WEIGHT, AT LEAST TWO PEOPLE ARE
REQUIRED TO LIFT THE CENTRIFUGE FROM THE PALETTE AND
PLACE IT ON THE BENCH.**

2.2 Installation

2.2.1 General Placement

The centrifuge should be installed in a dust and corrosion free room.

Place the centrifuge on a bench top capable of supporting the specified weight (see Section 2.3). Be sure there is approximately 12 in. of clearance on all sides of the unit.

2.2.2 Inspection

Before installation, the centrifuge should be thoroughly inspected for corrosion and cleanness (see **Section 5 – Maintenance**). The clip in the center of the rotor and the drive spindle should also be clean and undamaged: these parts should be wiped over before each use.

Any failure to follow the above advice may have serious consequences for the safety of the appliance.

2.2.3 Electrical Connection

Attach the power cord to the receptacle on the rear panel of the centrifuge. Plug the power cord into the appropriate 3-wire grounded power receptacle. If an extension cord is required, use only a 3-wire grounded cord rated for the correct voltage for your unit (120 VAC/15 A or 220 VAC/7.5 A).

WARNING

TO AVOID ELECTRICAL SHOCK, CONNECT THE POWER CORD ONLY TO AN APPROVED POWER SOURCE SUCH AS A 3-WIRE GROUNDED RECEPTACLE. WHERE A 2-WIRE RECEPTACLE IS ENCOUNTERED, HAVE IT REPLACED WITH A PROPERLY GROUNDED 3-WIRE RECEPTACLE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE. DO NOT, UNDER ANY CIRCUMSTANCES, REMOVE THE GROUND PRONG FROM THE POWER PLUG.

SHOULD THE POWER CORD OR PLUG BECOME CRACKED, FRAYED, BROKEN, OR OTHERWISE DAMAGED, REPLACE THE CORD OR PLUG IMMEDIATELY.

UNPLUG THE POWER CORD BEFORE ANY MAINTENANCE OR SERVICING.

NEVER ATTEMPT TO OVERRIDE THE ELECTRICAL SAFETY INTERLOCKS OF THE CENTRIFUGE.

2.2.4 Lid Unlock

- 1 Switch the centrifuge on by flipping the power switch on the right side of the machine to the on position.
- 2 When the centrifuge is switched on and not spinning the NOT IN USE LED will be lit.
- 3 To open the lid, pull the lever on the right side of the machine towards the centrifuge front.

WARNING

BEFORE PROCEEDING, REMOVE POWER TO THE CENTRIFUGE BY MOVING THE POWER SWITCH TO THE "OFF" POSITION.

- 4 After opening the lid, remove any packaging around the driving spindle. Unscrew the rotor head nut from the motor shaft. Carefully clean the inside of the centrifuge chamber removing any packing residues. Due to the air-whirling, solid particles accidentally left in the centrifuge chamber would create excessive wear of the chamber itself and of the rotors.

2.2.5 Assembly of the Rotating Head

The rotor's drive is made by means of two pins inserted in the rotor's shaft which must be aligned with the milling of the rotor. For a correct mounting follow the instructions below:

- Ensure that both the spindle of the motor and the hole of the head are clean. It is suggested that you apply a light coat of lubrication with a light oil or silicone spray.
- Insert the head in the centrifuge protective bowl and slip it onto the spindle with the milling of the collar face down.
- Align the milling in the collar with the pins on the spindle.

Screw and slightly tighten (with the supplied key) the hexagonal nut on the threaded spindle of the motor unit.

2.3 Specifications

Physical Dimensions	
Height	14.8 in. (37.5 cm)
Width	15.7 in. (40 cm)
Depth	18.9 in. (48 cm)
Net weight	88.2 lb. (40 kg)
Clearance (sides and rear)	11.8 in. (30 cm)
Clearance (top)	26.2 in. (66.5 cm)

Table 1 – Physical Dimensions

Environmental Requirements	
Non-Operating (Storage) Conditions	
Temperature	−4° F → 122° F (−20° C → 50° C)
Relative humidity	Up to 90% non-condensing
Operating Conditions	
Temperature	14° F → 104° F (−10° C → 40° C)
Relative humidity	80% for temperatures up to 88° F (31° C) decreasing linearly to 50% at 104° F (40° C)
For indoor use, in a dust and corrosion free room	
Maximum Noise	<63 dBA

Table 2 – Environmental Requirements

Electrical Requirements		
	CA6000, 220V	CA6000, 120V
Input Voltage	230V +5%, −10%	120V +5%, −10%
Input Line Frequency	50 Hz (1 phase + earth)	60 Hz (1 phase + earth)
Nominal current	3.5 A	6.8 A
Maximum Total Power	520 W	
Maximum Total Power (steady state)	350 W	
Maximum power requirement	870 VA	
Insure proper grounding of all outlets		

Table 3 – Electrical Requirements

The centrifuge is provided with RFI Filters. The manufacturer declines all responsibility for any damages due to non-grounding of the centrifuge.

Centrifugation Characteristics	
Maximum Allowable Capacity	Swing-out: (4 x 280 ml) $1120 \times 10^{-6} \text{ m}^3$
	Fixed-angle: (6 x 94 ml)
Maximum Allowable Density	1200 Kg/m ³
Maximum Allowable Weight	1.34 Kg
Maximum Speed	Swing-out: 4000 rpm
	Fixed-angle: 6500 rpm
Maximum RCF at Tip	Swing-out: 2933 xg
	Fixed-angle: 5289 xg
Tachometer Accuracy	± 20 rpm of actual
Timer Accuracy	± .005% of set time

Table 4 – Centrifugation Characteristics

3 Controls and Indicators

3.1 General

This section describes the meaning and use of the controls and indicators of the Clay Adams™ CA6000 centrifuge. The overall layout of the unit is shown in Figure 3. The keypad is shown in Figure 4.

WARNING
**ALL SYSTEM USERS MUST BECOME THOROUGHLY FAMILIAR WITH
ALL CONTROLS AND INDICATORS BEFORE ATTEMPTING TO
OPERATE THE CENTRIFUGE.**

3.2 On/Off Switch

The On/Off switch is located on the right side of the centrifuge, at the bottom. When in the “I” (On) position, power is applied to the centrifuge. When in the “O” (Off) position, power is removed from the centrifuge.

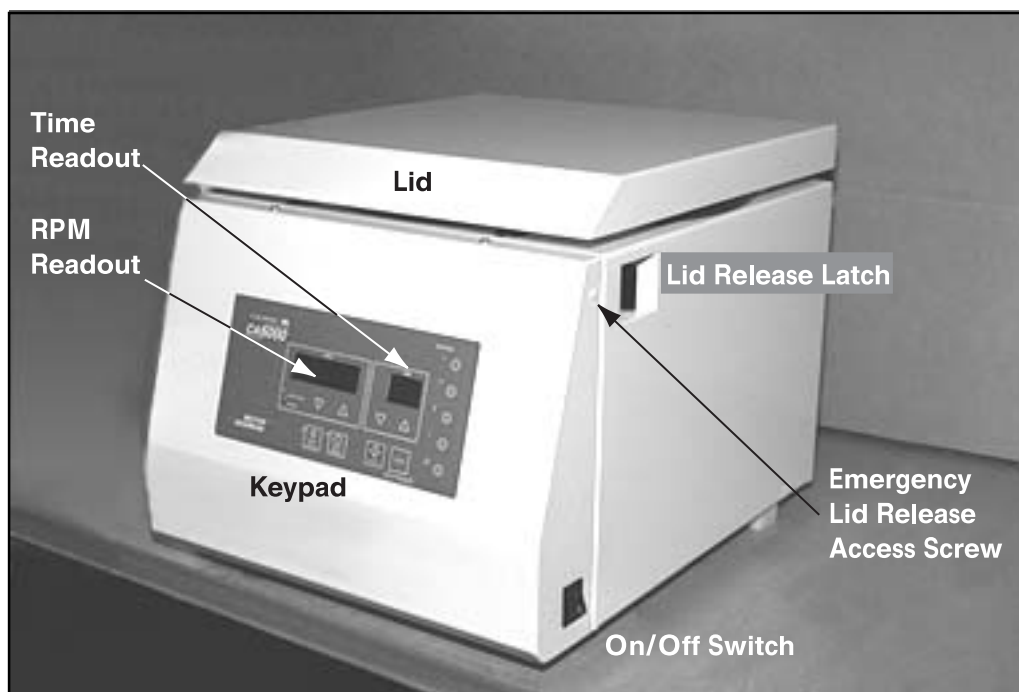


Figure 3 – CA6000 Centrifuge Layout

3.3 Lid Release Latch

The Lid Release Latch is located on the right side of the centrifuge, at the top front. Pull this latch forward to open the centrifuge lid.

Note that the Lid Release Latch does not operate when power to the unit has failed.

3.4 Emergency Lid Release Access Screw

The emergency Lid Release Access Screw is located on the right side of the centrifuge, just in front of the Lid Release Latch. In the event of a power failure, remove the screw to access the emergency lid release function (see Section 4.7).

3.5 CA6000 Keypad

The keypad is located at the center of the front panel. It presents all the keys and displays necessary to program, start, and stop operation of the centrifuge.

3.5.1 RPM Readout

When the centrifuge is stopped, the RPM Readout displays the speed setpoint (in revolutions per minute). It displays the actual speed when the centrifuge is spinning. When the readout is flashing, it indicates that the current speed/time setting can be entered into memory (Program 1 – 5).

3.5.2 RPM Set Keys

Press ▲ to increase or ▼ to decrease the speed setting. The speed can be set from 300 to 6500 rpm in 10 rpm increments.

3.5.3 NOT IN USE Indicator

When lit, this amber LED indicates that the rotor is not spinning and the lid **can** be opened.

3.5.4 IN USE Indicator

When lit, this amber LED indicates that the rotor is spinning and the lid **cannot** be opened.

3.5.5 Time (MIN) Readout

When the centrifuge is stopped, the time readout displays the time setpoint (in minutes). It displays the remaining time when the centrifuge is spinning. When the readout is flashing, it indicates that the current speed/time setting can be entered into memory (Program 1 – 5).

3.5.6 Time Set keys

Press ▲ to increase or ▼ to decrease the time setting. The time can be set from 1 minute to 99 minutes. The Hold (“Hd”) setting, located at the zero position, allows you to manually start and stop the centrifuge without presetting a time (i.e., spin for an indeterminate or infinite time).

3.5.7 SOFT ACCEL Key

This key is used to select soft acceleration modes. Press and hold the key until the RPM Readout shows “ACL” flashing and a number from 1 – 5. Use ▲ to increase or ▼ to decrease the acceleration profile number. Profile 1 is the slowest setting, increasing to Profile 5, the fastest setting.

3.5.8 SOFT ACCEL Indicator

This green indicator flashes when the centrifuge is accelerating to its setpoint. The LED remains on while the actual speed is at the setpoint.

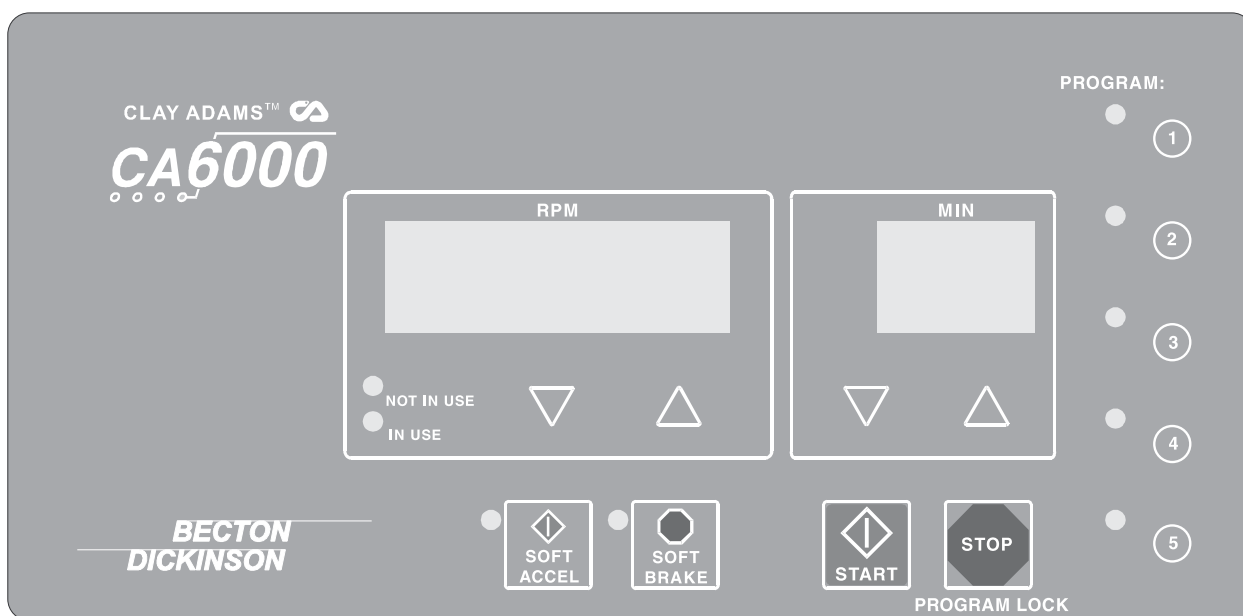


Figure 4 – CA6000 Centrifuge Keypad

3.5.9 SOFT BRAKE Key

This key is used to select soft deceleration modes. Press and hold the key until the RPM Readout shows “dCL” flashing and a number from 0 – 4. Use ▲ to increase or ▼ to decrease the deceleration profile number. Profile 0 represents a coast mode (no braking).

3.5.10 SOFT BRAKE Indicator

This green indicator flashes when the centrifuge is decelerating from its setpoint. The LED remains on while the actual speed is at the setpoint.

3.5.11 START key

Press to start a centrifuge cycle.

3.5.11 STOP/PROGRAM LOCK Key

Press this key to stop the centrifuge during its spin cycle.

Press this key ALONG WITH a PROGRAM Key to lock the program setting. When a program is locked, it cannot be changed unless it is unlocked.

3.5.12 PROGRAM Keys

When the RPM and Time (MIN) readouts are flashing, pressing one of the five PROGRAM keys saves the current speed/time settings in memory. When RPM and Time readouts are not flashing, pressing PROGRAM 1 – 5 recalls the speed/time settings stored in that memory location.

You can lock any of the programs while you are setting it by pressing the STOP/PROGRAM LOCK Key along with the desired PROGRAM Key. When locked, a program cannot be changed. To unlock a program, press the STOP Key along with the appropriate PROGRAM Key.

3.5.13 PROGRAM Indicators

When a preset program (1 – 5) is selected, the amber LED next to the PROGRAM number lights.

4 Operation

WARNING

USE ONLY THE ROTORS, BUCKETS, INSERTS, AND OTHER ACCESSORIES SPECIFIED IN APPENDIX B – PARTS AND ACCESSORIES.

DO NOT OPERATE THE CENTRIFUGE WITH SPECIMENS OR MATERIALS HAVING A DENSITY GREATER THAN 1200 KG/M³. DOING SO MAY CAUSE DAMAGE TO THE CENTRIFUGE, AND MAY CAUSE UNSTABLE OPERATION AND CAUSE THE CENTRIFUGE TO MOVE OFF OF THE OPERATING SURFACE.

DO NOT OPERATE THE CENTRIFUGE IN ATMOSPHERES CONTAINING FLAMMABLE OR VOLATILE GASES. DO NOT USE THE CENTRIFUGE TO SPIN DOWN FLAMMABLE OR VOLATILE LIQUIDS.

4.1 CA6000 Centrifuge Setup for Operation

Turn the On/Off Switch to the On (I) position.

The CA6000 will be in the same operative mode as the last time it was used.

Open the lid by pulling the Lid Release Latch (located on the upper right side of the centrifuge) toward the front of the centrifuge.

4.2 Loading Balance

All rotating equipment is dynamically balanced at the source. Reference numbers and marks indicate the exact respective positions of the various parts forming the equipment; when rotating, this should always be whole and complete.

All buckets must be always inserted into the rotating fixed-angle equipment, even for partial loads.

WARNING

NEVER ATTEMPT TO BALANCE THE LOAD BY ADDING WEIGHTS, MERCURY, OR METAL SHOT TO THE BOTTOMS OF TUBES OR SHIELDS. ONLY THE PROPER BUCKETS, INSERTS, AND TUBES SHOULD BE PLACED IN THE CENTRIFUGE.

Distribute the load correctly. Loads should be inserted two by two, of equal weight, at 180° from the rotation axis and at equal distance (radius) from the center of rotation. Use matching inserts when balancing the rotor. When spinning an odd number of samples, even the load by inserting a “balance tube” filled with water.

For partial loads of swing-out rotating equipment, it is advisable to distribute the tubes symmetrically also with regard to the center of rotation.

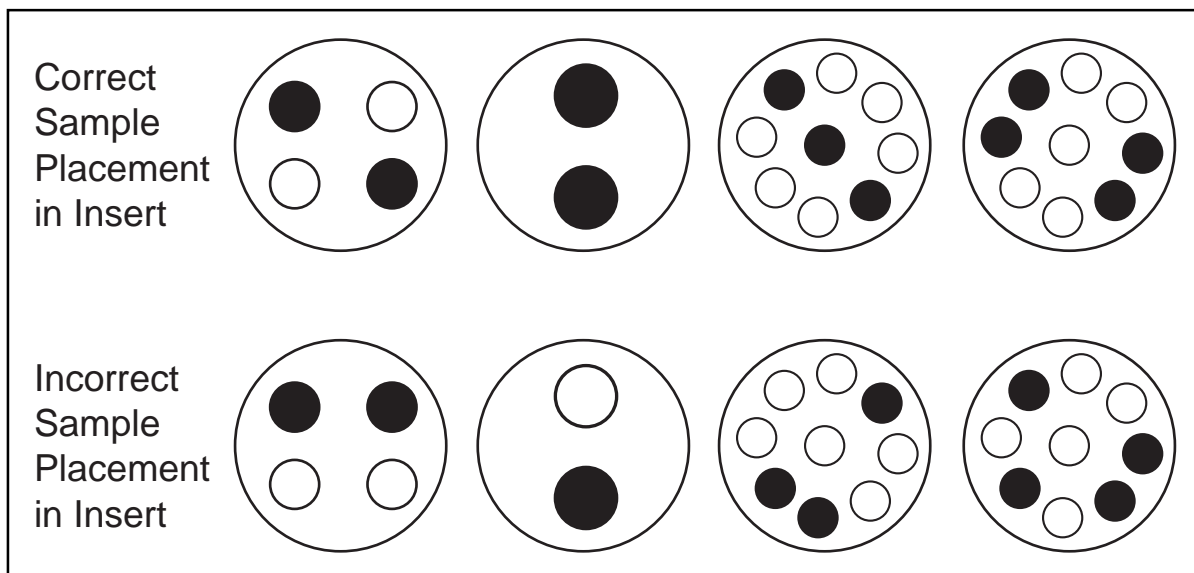


Figure 5 – Loading Balance

Avoid overloading the rotating equipment. To centrifuge liquids with density higher than 1200 kg/m³, the maximum rpm should be reduced. Calculate the new allowable rpm using the following formula:

$$\text{New allowed rpm} = \text{max rpm} * \sqrt{\frac{1200}{\text{New Density}}}$$

Lower the lid, then close it by pressing on the front edges until the hook in the lid clicks into the lid lock mechanism. Only this operation will activate the centrifuge starting device.

When using the aerodynamic rotating heads, all tubes must be balanced with ± 2 grams, in order to obtain the best separation.

4.3 Rotating Equipment Performance

Type of Equipment	Load Composition		Accessories		Useful Max. Radius in. (m)
	Capacity	Angle	Bucket	Sealing Cap	
42601001	4x280 ml	0 – 90°	42601009	42601002	6.46 in. (.164 m)
42601026	6x50 ml con.	40°			4.41 in. (.112 m)

Performance Table

Type of equipment	Max. Speed (rpm)	Max. RCF (xg)
42601001	4000	2933
42601026	6500	5289

RCF Calculation

The main factors of the centrifuge action in terms of correct analysis methodology are: the centrifugation time and the gravity number “xg” (relative centrifugal force) to which the product is submitted. The formula allows the determination, as a function of the radius “r,” of the relative centrifugal force value, expressed in multiples of the gravity acceleration value “g” (9.9 m/sec²) for each rpm value between 150 and 20,000.

The relative centrifugal force and the RPM number are connected by the following relations:

RPM in thousands =

$$\sqrt{\frac{\text{RCF}}{28.4r}}$$

where RCF = relative centrifugal force specified for the particular centrifugation procedure
r = Tip radius of tube (in inches) obtained from the chart above

4.4 Selecting Operating Modes

Instructions for setting the following parameters are provided in this section:

- ◆ Rpm centrifugation (300 rpm up to 6500 rpm)
- ◆ Centrifugation time (1 minute up to 99 minutes, plus “Hold”)
- ◆ Acceleration (Profiles 1-5)
- ◆ Deceleration (0-4 Coast-down; 0 inertial)

Setting Acceleration

To select an acceleration profile, use the following procedure:

- 1 Press and hold the SOFT ACCEL key for approximately 3 seconds, until the rpm display shows "ACL" flashing and a number between 1 and 5.



- 2 Use the ▼▲ keys to select a profile. 1 is slowest.

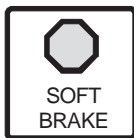
High acceleration (LED off)

Low acceleration (LED on)

Setting Deceleration

It is possible to select various low coast-down deceleration curves, corresponding to several profiles of decreasing speed.

- 1 Press and hold the SOFT BRAKE key for approximately 3 seconds, until the rpm display shows "dCL" flashing and a number between 0 and 4.



- 2 Use the ▼▲ keys to select a profile. 0 is coast mode (no braking).

High deceleration (LED off)

Low deceleration (LED on)

Setting Rpm, Time (MIN) Profiles

To set rpm or cycle time, press and hold the ▼ or ▲ key located under the respective parameter. Release the key when the desired value is reached. The display will flash for 3 seconds after the adjustment key is released and then stop, indicating that the new parameter is accepted.

How to Set and Memorize a Program

To store the parameters that appear on the display, press a PROGRAM key from 1 to 5 while the parameter is flashing (the display flashes when setting rpm, minutes, soft acceleration, or deceleration). When the LED next to the program key is lit, the program has been memorized.

It is not possible to set a program with unspecified "Hold" (Hd) time: the timer display will continue flashing; you must insert a determined time profile.

To restore "manual mode," press again the selected program key; the LED goes off and you can make new parameter selections.

How to Protect a Program

- 1 To protect a program from overwriting, when you memorize a new program (pressing a PROGRAM key during flashing phase) you must press simultaneously STOP/PROGRAM LOCK key.
- 2 To cancel the program protection, press the PROGRAM key together with the STOP/PROGRAM LOCK key.

4.5 Starting the Centrifuge

- 1 Make sure the lid is closed.
- 2 Press the START key.
- 3 The Centrifuge accelerates to the set speed.

The yellow NOT IN USE LED goes off, and the IN USE LED lights.

The green SOFT ACCEL LED starts flashing. This LED stays on when the set speed equals the actual speed. (Note that if the set rpm is higher than the maximum speed of the selected rotor (see Section 4.3), the LED continues flashing.)

- 4 During the run time all displays show real parameters: Rpm, Time (min – elapsed run time in minutes counts down or remaining run time counts up if you have set a time of “Hold”). If you are running a Program, you can show set values by pressing the corresponding arrow key.

If your parameters have been set manually it is possible to change them. To change the rpm or time, use ▲▼. To change the deceleration mode, press and hold the SOFT BRAKE key for about 3 seconds. The Readouts start to flash and show the set values for 3 seconds. While the Readout flashes it is possible to change set values.

- 5 When the run time is completely elapsed, deceleration will take place.

4.6 Stopping the Centrifuge

Once the preset time has elapsed, the centrifuge automatically stops with the preset deceleration mode.

However, in any situation you can press the STOP key to stop the centrifuge.

Note that the cycle will be interrupted automatically for load imbalance, power failure, system error, or breakdown.

If this occurs, the relevant information appears on the message display.

4.7 Emergency Lid Unlock

In the event of a power failure, the lid can be opened using the special tools supplied with the centrifuge.

This operation should be performed with the power disconnected.

- 1 Unscrew the nylon screw in the hole on the right side of the centrifuge, just in front of the Lid Release Latch.
- 2 Insert the unlocking tool supplied with the centrifuge in the hole.
- 3 Pivot the unlocking tool downward, and at the same time pull the Lid Release Latch forward.
- 4 Reinstall the nylon screw

WARNING

SHOULD A POWER FAILURE OCCUR DURING CENTRIFUGATION, WAIT FOR TEN MINUTES. IF THE ROTOR IS STILL SPINNING, CLOSE THE LID AND WAIT ANOTHER TEN MINUTES BEFORE RE-PEATING THE OPERATION.

5 Maintenance

WARNING

DURING MAINTENANCE OPERATIONS, ALWAYS DISCONNECT THE CENTRIFUGE FROM THE POWER SOURCE. OTHER THAN ROTOR AND EXTERNAL FUSE REPLACEMENT, REFER SERVICING TO QUALIFIED PERSONNEL.

5.1 Disassembly of the Rotating Head

Remove the head nut securing the rotor to the motor shaft. Lift the rotor straight up.

5.2 Rotating Equipment and Centrifugation Chamber Cleaning

Regular cleaning of the rotating heads and centrifugation chamber is vital for correct operation of the centrifuge.

At a minimum the unit should be cleaned weekly in warm water containing a few drops of mild nonalkaline detergent. The centrifuge should always be cleaned immediately after a spillage has occurred. Do not forget to wash the core of the rotating head which comes into contact with the drive spindle. Each pocket of the rotating heads, slots, and buckets must be washed thoroughly using a small nylon brush.

CAUTION

Do not use metal wire brushes to clean the centrifuge.

Once the rotating equipment is clean, rinse it in running water, preferably distilled. Dry the rotating equipment with a soft absorbent non-woven cloth or tissue. Drying may be finished off with warm air jet (e.g., a hair dryer).

MAKE CERTAIN THAT ROTATING HEADS, SLOTS, AND BUCKETS ARE WELL DRIED.

NEVER LEAVE damp rotating equipment on a metal surface, particularly stainless steel. An electrochemical reaction could take place with the aluminum or magnesium in the rotor.

For swing-out rotating equipment, be sure to clean the dirty grease from the studs and replace it with a small amount of fresh grease. This will ensure that the buckets swing freely. The vast majority of apparent imbalance problems arise from the failure of the user to clean and grease the studs, not from instrument error.

Never apply grease if studs and balancing slots have not been carefully cleaned. Use only the same kind of grease furnished in the rotor head packaging.

Once the rotating head has been removed, it is easy to clean the centrifugation chamber (do not use corrosive solvents or detergents).

5.3 Exterior Cleaning

For a correct cleaning a light domestic use detergent is recommended. A mixture of 50% isopropanol and water is suggested because it will not damage the labels.

5.4 Disinfection

Autoclave rotating equipment for 20 minutes at 120° C to destroy microorganisms.

Rotor lids must be disassembled from rotor bodies. "O" rings, autoclaved separately, should be replaced when deformed.

Any part which has been subjected to temperatures above 130° C must be discarded.

Household bleach used at 10% concentration with 10 minutes immersion is effective against bacteria, spores, and viruses but, as an oxidizing agent, is corrosive to metal alloys and **must be thoroughly rinsed off and dried**. It should never be used if there is surface damage to the rotating equipment.

Note that the black color on the surface of the rotating equipment will be gradually washed out if the rotor is regularly autoclaved or bleached. This does not necessarily denote a degradation on the anodization.

If there is a biological liquid overflow there may be the possibility of a discharge into the drain hose. Do not forget to proceed to the decontamination with the same household bleach (10%).

For any other unscheduled cleaning, the customer must contact Becton Dickinson to verify that the proposed method does not damage the centrifuge.

NOTE

Becton Dickinson makes no claims as to the effectiveness of proprietary brands or decontaminating solutions.

5.5 Radioactive Decontamination

We recommend that all radioactive decontamination be referred to your Radioactivity Safety Officer.

After decontamination, the unit should be cleaned as described above (Section 5.4).

5.6 Fuses

There are two fuses in the power entry module. The fuses are located in a drawer just below the power cord plug.

These fuses are:

Diameter 5 x 20 mm F6A/250V

WARNING

**BEFORE BEGINNING TO CHANGE THE FUSES, MAKE SURE THE
UNIT'S POWER IS TURNED OFF AND DISCONNECT THE CENTRI-
FUGE POWER CORD FROM THE POWER SOURCE.**

In case of fuse blowing, do not replace them until the machine has been inspected by a maintenance engineer.

Troubleshooting

6.1 Alarm Messages

Below is a list of error messages and their meaning.

MESSAGE	MEANING
End	Appears at the end of every centrifugation cycle. Indicates a stationary centrifuge. The message disappears at the next operation (e.g., pressing a key or opening the lid).
Lid	Appears when the START key is pressed and the lid is open (or apparently closed but not locked). In addition, an audible alarm sounds. The lid must be closed to clear the message and start the centrifuge.
ImbAL	Appears when the load is imbalanced. An audible alarm also sounds. The centrifuge stops and you must rebalance the load to continue. The message disappears when the lid is opened.
MAInS	Appears when a power failure occurs. The centrifuge decelerates and when power returns the message appears. The message disappears at the next operation.
SET	Appears during centrifugation when a program uses a set speed higher than the rotating equipment maximum speed. The message disappears when the centrifuge is stopped or the parameter is corrected.
EXX Messages	"EXX" (e.g., E01) together with an audible alarm means a failure condition. The "E04" message appears on the display after a power failure. In this case wait for the rotor head to stop before opening the lid. For all other EXX codes, contact Becton Dickinson Instrument Repair.

6.2 Other Problems

Symptom	Possible Cause	Corrective Action
Unit fails to operate	Power cord is not plugged into receptacle	Plug power cord into receptacle (Section 2.2.3)
	Lid is not latched	Close lid and latch securely
	Line fuse is blown	Replace fuse (Section 5.6)
	Defective internal parts	Call Becton Dickinson Instrument Repair
Brake fails to decelerate rotor	Brake system defective	Call Becton Dickinson Instrument Repair
Centrifuge vibrates excessively	Unbalanced load	Balance load (Section 4.2)
	Rubber feet worn	Replace feet
Display not working	Defective display module or other internal parts	Call Becton Dickinson Instrument Repair
Centrifuge fails to achieve maximum speed specified for rotor	Line voltage incorrect	Check power source
	Defective speed control, tachometer, or motor	Call Becton Dickinson Instrument Repair
Lid fails to open	Defective lid solenoid or internal parts	Call Becton Dickinson Instrument Repair

Becton Dickinson Instrument Repair: 1–800–544–7434

6.3 Repair

Please refer all repairs to a qualified Biomedical Engineer.



Limited Warranty

Becton Dickinson warrants the Clay Adams CA6000 Centrifuge to be free from defects in workmanship and materials for a period of 18 months from date of installation, provided the Centrifuge is operated in accordance with this User's Manual. During such period, Becton Dickinson agrees to ship replacement parts at no additional costs to the user which, in Becton Dickinson's sole judgment, are found to be defective, provided the Centrifuge has not been subjected to misuse or abuse. The warranty stated herein shall extend to the original consumer only and not to any subsequent consumer of the Centrifuge.

Becton Dickinson shall not be liable for any incidental or consequential damages. Becton Dickinson makes no other warranties, expressed or implied, except as stated herein.



Parts and Accessories

Item	Catalog Number
Rotor, Swing Out, with 4 Buckets	42601001
Sealing Cap	42601002
Rotor Only	42601011
Bucket Only	42601009
Insert, 2x50 ml (Total Capacity 8)	42601003
Insert, 9x15/10 ml (Total Capacity 36)	42601004
Insert, 4x15 ml (Total Capacity 16)	42601005
Insert, 19x5 ml (Total Capacity 76)	42601006
Insert, 12x7 ml (Total Capacity 48)	42601007
Insert, 12x5 ml (Total Capacity 48)	42601008
Rotor, Fixed Angle 6 Place	42601026
Insert, 1x50 ml (Total Capacity 6)	42601027
Insert, 1x16/15 ml (Total Capacity 6)	42601028
Insert, 1x2.0/1.5 ml (Total Capacity 6)	42601029

Item (Exploded View Bubble Number)	Catalog Number
Lid/Bowl Seal (9)	42601012
Motor Chamber/Bowl Seal (8)	42601013
Motor (12)	42601014
Display PC Board (11)	42601015
Load Imbalance Sensor (13)	42601016
Power Supply Rack Assembly (7)	42601017
Keypad (3)	42601018
Microprocessor Power PC Board (10)	42601019
Power Switch (2)	42601021
Power Entry Module (16)	42601022
Gas Spring (4)	42601023
Lid Locking System (19)	42601024
Clay Adams CA6000 Centrifuge User's Manual	42601025



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Exploded View Drawing

